THE TEETH AND TONSILS AS CAUSATIVE FACTORS IN ARTHRITIS.

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From the earliest days of medical science the teeth and tonsils have been considered as having a causal relationship to arthritis. This is shown by the use of the terms "rheumatic tonsils" and "gouty gums." These conditions were formerly supposed to be induced by exposure to cold or to an excess of uric acid or lactic acid in the blood, or to some unknown disturbance of the metabolism.

Of late years the infectious theory of arthritis has been steadily gaining ground. This theory results from the discovery of microorganisms in or around the joints and also because arthritis has been observed frequently to follow various local and general infections.

The conception that a general systemic disease, such as arthritis, could arise from a local infection was appreciated early in the development of medical science. Until recent years, however, the apparent connection was recognized only when a condition of surgical sepsis preceded the arthritis.

The newer concept of the subject, to which the term focal infection has been applied, presupposes a circumscribed area of tissue infected with microörganisms. This area of infected tissue, the primary focus, is generally obscure in nature, often difficult to locate, and usually has no apparent connection with the secondary focus located in the articular structures. The broader interest in this subject has been brought about by a better knowledge of bacteriology, of modes of infection and by coöperative laboratory and clinical research.

Chronic infection of the tonsils and lymphoid tissue of the nasopharynx is exceedingly common in childhood, while acute rheumatic fever is relatively rare at that age. On the other hand the onset of rheumatic fever following an infection of the mouth and throat is too well recognized to be controverted.

Alveolar abscess is so prevalent as to be regarded as well-nigh universal, and yet it is not commonly associated with systemic infection. The protective forces surrounding the abscess are so efficient in the great majority of instances, and the lesion becomes so thoroughly walled off, that many thoughtful physicians and dentists deny the possibility of this condition becoming a focus of infection except on rare occasions.[1]

[1] Billings, Frank: Focal Infection, New York, 1916, 6.

In certain cases, however, the etiological relation of localized infection to both acute and chronic systemic disease seems too evident to be set aside. Numerous cases reported by various workers testify to the marked improvement observed when a localized area of infection has been removed.

The bacteria most commonly found in areas of local infection are the members of the streptococcus group. Their usual habitats are the regions of the teeth, the tonsils and the nasal accessory sinuses. Careful questioning will often elicit symptoms pointing to existing infection in these structures or in some other part of the body.

A coöperative study of the patient should be made, including examinations by dentists, by ear, nose and throat surgeons, and when necessary by other specialists. A careful roentgen-ray study of the teeth and accessory sinuses is always advisable and frequently absolutely indispensable.

Laboratory examinations of pathological material should always be made. Cultures should be taken from the depths of tonsillar pockets and alveolar abscesses and not from the surface of the gums or tonsils.

In addition, it is necessary to examine fluid aspirated from joints or small bits of synovial membrane or lymph glands, or muscle tissue may be removed for pathological study. A Wassermann test should always be made to eliminate a syphilitic joint involvement.

The work of Rosenow[2] has shown what is apparently a remarkable transmutability of the members of the streptococcus group. A strain of the Streptococcus viridans isolated from the blood of a case of chronic infectious endocarditis was cultivated in various media, and animals were inoculated with successive strains. The end-result was a pneumococcus. The bacteria were typical pneumococci and transmutation of the original pure culture of Streptococcus viridans had occurred in form, cultural characteristics and in general and special pathogenic virulence for animals. Rosenow has also observed that the property of transmutation is reversible within the members of this family.

Many eminent bacteriologists in this country have been unable to duplicate Rosenow's[3] experiments in bringing about transmutation of the members of the streptococcus group, and his conclusions are not accepted by many equally prominent laboratory workers.

The results of Rosenow's experiments show that the streptococci often have a remarkable affinity or tropism for the organs or tissues from which they were isolated.

At autopsy oftentimes no other focal lesions could be found

[2] Transmutations within the Streptococcus Pneumococcus Group, Jour. Infect. Dis., 1914, xiv, 1.

[3] Elective Localization of Streptococci, Jour. Am. Med. Assn., 1915, lxv, 1687.

except those in the organ in question. The cells of the tissues for which a given strain shows elective affinity take the bacteria out of the blood stream as if by a magnet.

Individual animals, like human beings, are found to vary in their ability to resist infection. Certain virulent bacteria seem to have the property of rendering the tissues less favorable for their growth. On the other hand the less virulent bacteria tend to make this soil more favorable. Some property evidently exists in the tissues of the individual harboring a focus of infection which permit the bacteria to develop changes in virulence under varying degrees of oxygen pressure and in mixed culture. The susceptibility of the host is far more important than the specificity of the infecting microörganism.

Diseased Conditions of the Teeth and Arthritis. Over a century ago Benjamin Rush[4] reported the cure of a case of rheumatism in the hip-joint by extracting a tooth. Referring to decayed teeth he says: "I am disposed to believe that they are often the unsuspected causes of general and particularly of nervous diseases. . . . Our success in the treatment of all chronic diseases would be very much promoted by directing our inquiries into the state of the teeth in sick people and by advising their extraction in every case in which they are decayed. It is not necessary that they should be attended with pain in order to produce diseases." In the light of modern scientific work the above statement is almost prophetic.

Apparently no further attention was paid to this subject until the latter part of the nineteenth century, when we find Ingersoll,[5] Witzel[6] and Reese[7] advocating the removal of all decayed teeth which are not absolutely necessary for good articulation. In 1899 William Hunter[8] called attention to diseased conditions in the teeth, gums and alveolar processes and suggested the term "oral sepsis" or medical sepsis. He believed it to be of much more common occurrence than surgical sepsis. His article included a scathing denunciation of American mechanical dentistry, with special reference to crown- and bridge-work and the stomatitis existing under artificial plates. With our present knowledge this criticism was more or less justified.

Shortly afterward Price[9] referred to root canals as the "dentists' graveyard, where so many cover up careless and defective work, trusting it will never come to light."

[4] Medical Inquiries and Observations, Philadelphia, 1819, i, 1917.
[5] Sanguinary Calculus, Ohio State Jour. Dent. Sc., 1899, i, 189.
[6] The Treatment of Pyorrhea Alveolaris or Infectious Alveolitis, British Jour. Dent. Sc., 1882, xxv, 153.
[7] Uremia and its Effects upon the Teeth, Dental Cosmos, 1886, xxviii, 550.
[8] Dental Diseases in Relation to General Diseases, Especially to Infective Gastritis, Odont. Soc. Tr., 1898-99, xxi, 92.
[9] Practical Progress in Dental Skiagraphy, Items of Interest, 1901, xxiii, 458.

Broomell[10] called attention to the deleterious effects of inserting large gold fillings near living tooth pulps and likewise the placing of gold-shell crowns without removing the pulp. Chayes[11] has characterized mechanical bridge-work as unsatisfactory, incomplete, unwholesome and unclean.

Kenneth Goadby[12] was the first to point out the direct relationship of dental infections to joint infections. By the removal of infected teeth he was able to produce a cure in 3 cases, one of which had been completely disabled for many months. From these patients he isolated an organism which he called the Streptobacillus malæ. This organism by animal inoculation produced joint disease in rabbits

Hartzell and Henrici[13] have for several years conducted a systematic research, including animal inoculation, into the relationship of mouth infection to metastatic infection of other parts of the body. Patients presenting joint infection were referred to them for investigation and treatment of mouth conditions. A complete roentgenographic examination of the teeth and jaws was first made. Whenever dental abscesses were present the abscessed teeth were isolated with dry gauze, the tooth or root was cleansed with iodin and wherever possible the tissue about the neck of the tooth was cauterized. The tooth was extracted and the root tip amputated with sterile forceps and immediately dropped into culture media. The resulting growth has invariably produced, among other bacteria, the Streptococcus viridans. This organism was found in the confined dental abscess, in the superficial tissues of the peridental membrane and even in the roots of healthy living teeth. These writers believe that the dental path is commonly infected with this organism.

Susceptibility of the Tooth to Infection. Certain anatomical conditions resulting from the development of the teeth render them particularly susceptible to infection from without. The union of the mucous membrane to the tooth structure is always imperfect and capable of admitting infection. The dental structure has no protecting device save its coat of enamel. If this be in any way imperfect there are no antibodies or protecting leukocytes in the saliva to save it from the disintegrating effect of bacterial action.

The structures about the tooth are not well adapted to resist infection from the tooth. The gingival crevice, or gum marginal crevice, is protected externally by tough pavement epithelium, but has almost no epithelial protection at its point of union with the tooth itself. Through destruction of enamel, dentin and from

[10] The Adventitious Effects of Large Masses of Gold in Contact with Tooth Tissues, Dental Cosmos, 1910, lii, 389.

[11] Empiricism of Bridge-work, Items of Interest, 1910, xxxii, 745.

[12] The Relation of Diseases of the Mouth to Rheumatism, Practitioner, 1912, lxxxviii, 107.

[13] The Dental Path: its Importance as an Avenue to Infection, Surg., Gynec. and Obst., 1916, xxii, 18.

suppurating pulps the teeth present 32 separate sources of infection. There are also 32 open dental alveoli and 30 spaces between the teeth which are susceptible to infection. The generous blood supply at this point allows microörganisms to pass readily into the openings in the bottom of this crevice and so into the deeper tissues by way of the lymph and blood streams.

Microörganisms have been found in freshly opened pulp chambers where no evidence of disease existed. A putrescent mass in the pulp chamber may exist for months or years because the walls cannot collapse and are incapable of bringing about the natural cure of an abscess as is possible in other parts of the body.

Pyorrhea Alveolaris. This disease has been recognized for several centuries, but was first described by Riggs in 1867. It is strictly a disease of the peridental membrane and is indicated by a progressive destruction of the root membrane of the tooth commencing at the gingival border, generally accompanied by a flow of pus and destruction of the alveolar walls. Pus is absorbed into the blood and lymph channels, into the tissues adjacent to the teeth and from the gastro-intestinal tract by swallowing. A few years ago a considerable furor was created in the profession by the discovery of the Endameba buccalis in the pyorrheal pockets of those suffering from the disease. This protozoa had been long known, but Barrett[14] was the first to consider it as an etiological factor in pyorrhea alveolaris. Bass and Johns[15] believe it to be the cause of this disease.

On the other hand, Sanford and New[16] hold that before Endameba buccalis can be regarded as the cause of pyorrhea alveolaris its pathogenicity must be demonstrated by animal experimentation. They also believe that before the alkaloids of ipecac can be accepted as the cure of this disease it must be established that they actually destroy the amebæ in the mouth.

Billings[17] believes that the endamebæ play an important part and permit infection with the pyogenic bacteria. The bacteria are the important factors in causing the general infection.

Roentgenography in Dental Conditions. The roentgen rays are of the greatest value in accurately diagnosing certain diseased conditions of the teeth which are considered to have an etiological relation to arthritis. Probably its greatest field of usefulness is in locating abscesses around the apices of non-vital teeth. Such infections may occur without pain and without clinical evidence of their presence. If their location is such that they can discharge

[14] The Protozoa of the Mouth in Relation to Pyorrhea Alveolaris, Dental Cosmos, 1914, lvi, 948.

[15] Pyorrhea Dentalis and Alveolaris; Specific Cause and Treatment, Jour. Am. Med. Assn., 1915, lxiv, 553.

[16] The Relation of Amebiasis to Pyorrhea Alveolaris, Surg., Gynec. and Obst., 1916, xxii, 27.

[17] Focal Infection, New York, 1916, 6.

their contents into the system—for example, by way of the antrum—their presence may remain unsuspected until diagnosed by the roentgen rays. In other teeth the abscess may protrude as the familiar gum-boil, which ruptures and may finally establish a fistula.

It must be clearly stated at the outset that an abscess may exist which cannot be revealed by the roentgen rays. This is because the pus is thinly distributed in a certain area or because the bone has not been sufficiently robbed of its lime salts to make this loss clear on the roentgenogram. The first appearance is a small area of slight bone rarefaction around the root apex. This process may go on to destruction of bone with cavity formation, resulting in the blind dental abscess or a fistulous connection with the mouth may be established. These blind abscesses often heal spontaneously. Under such favorable conditions the laying down of lime salts and the subsequent regeneration of bone can be followed with precision in roentgenograms made at intervals.

The interpretation of dental roentgenograms is full of pitfalls. Unless one is familiar with dental anatomy and pathology, and the varying appearance of shadows produced by roentgenograms taken from different angles, serious errors will be made. It is possible to take a roentgenogram from such an angle that an apical abscess is apparently demonstrated. A plate or film made from a slightly different angle will disclose only the normal bone surrounding the tooth apex. The reason for this error lies in the fact that at certain angles the shadows of the nasal cavity or antrum may overlie the tooth root and simulate the appearance of an abscess.

The point is that an apical shadow merely signifies decalcification of bone from any cause. It may represent a slow change, such as atrophy or absorption from long-continued irritation or pressure; it may mean an acute infective process or it may signify the remains of former disease—scar tissue. These shadows do not necessarily indicate the presence or absence of pus. This fact can be determined only by a study and correlation of the symptoms and clinical findings.

Other conditions which may cause symptoms referable to the teeth, and which can be differentiated by the roentgen rays, are calcareous concretions or stones in the pulp of the teeth, cysts of the jaw, dentigerous cysts and unerupted or impacted teeth.

Relation of Dental Infection to Systemic Conditions. In many cases there is a tendency to overestimate the role of these infections in causing more serious diseases. It is difficult to establish the etiology, as, for example, in a case of chronic arthritis of several years' standing. Dental examination shows several non-vital teeth. The roentgenogram may reveal any degree of change from a slight rarefaction of bone to a blind abscess. The teeth have been filled for many years and have given no trouble. The joint infection is hematogenous and a certain percentage of periapical

infections are hematogenous. Why may not both of these infections have resulted from a mild general bacteriemia and have developed coincidentally? Also, if the joint condition came first, why may it not have caused the dental condition? Other infections are quite as likely the cause as those in the mouth. Arthritic cases by no means always clear up after mouth infection has been removed. Many innocent teeth are being sacrificed from insufficient data, such as a crudely interpreted roentgenogram. Worse than this, several fatalities from ill-advised extraction of teeth during periods of exacerbation have been reported. It is well to remember the remarkable ability of the tooth and adjacent structures to bring about the spontaneous cure of a blind dental abscess with no resulting systemic involvement. Were this not so the human race would long since have been exterminated.

Diseased Tonsils and Arthritis. The close connection between tonsillitis and arthritis has been recognized for at least a century and probably much longer. At times the joint and throat symptoms are simultaneous in their onset; at other times the tonsillitis precedes the arthritis and may even completely subside before the joint lesions develop. Subacute and chronic infectious arthritis are often associated with recurring attacks of tonsillitis, the tonsils lighting up previous to each fresh exacerbation of the joint lesions. On the other hand the tonsils may be the seat of a low-grade chronic inflammation lasting for months, with frequent outbreaks of a more acute character.

The pathological conditions to which the tonsils are subject are generally attributed to the peculiar anatomical structure of the crypts and their tendency to retain cellular débris. The crypts are tortuous and deep, extending nearly to the capsule; their walls are held in close apposition by pressure of the surrounding lymphoid tissue. The mouths of the crypts may be partially closed by the plica triangularis or the upper wall of the supratonsillar fossa, and, in addition, the supratonsillar crypts drain upward. The result is that a certain amount of débris is found in the crypts of all tonsils. Bacteria enter the crypts and develop under ideal conditions for growth. The cryptic epithelium is usually composed of only one or two layers of cells and offers little mechanical resistance to the entrance of foreign material. The conditions are thus seen to be ideal for the invasion of bacteria and the absorption of the toxic products of their growth.

Disease in the middle ear, the accessory sinuses, conjunctivæ, teeth and alveolar processes may be the cause of chronic disease of the tonsils. On the other hand, obstruction of the upper air passages by hypertrophy of the tonsils and adenoid overgrowth prevents proper drainage from the nasal cavities and accessory sinuses and leads to infection of the middle ear, the sinuses of the head and the mucous membrane covering the turbinate bodies.

In subacute and chronic arthritis the deep crypts almost invariably show pure cultures of the Streptococcus hemolyticus, which produce acute or chronic multiple arthritis when injected into animals

The presence of these organisms in the tonsillar crypts of patients with joint lesions and the experimental results in animals suggest a causal relationship of the tonsils to arthritis.

OPERATIONS ON THE TONSILS. The advocates of partial removal have been influenced by the possible loss of some unknown function which would be detrimental to the patient and have counselled against complete removal of the tonsils. Those who believe in the operation of complete tonsillectomy point out the fact that thousands of these operations have been performed of late years, with no untoward result which could be attributed to the loss of any possible functionating power. It is also said that the histological structure of the tonsils shows that their function, whatever it may be, is identical with that of other lymphoid nodules of the body. This function, they claim, would no more be missed than the removal of a small piece of skin.

In the absence of any definite theory as to their function it seems reasonable to believe that they have a purpose even if it has not so far been discovered. They should never be removed, especially in children, without adequate cause. Before advising ablation the physician should be convinced that the tonsil is so completely diseased that it cannot functionate properly. Many tonsils are capable of overcoming infection in certain of their crypts. As a result a healed process may be present which, to the inexperienced, would denote active disease.

Wright[18] and others assert that the tonsils enlarge regularly during the periods of dentition, the enlargements occurring about the second, sixth, twelfth and seventeenth years. These enlarged tonsils, if not infected, return to normal when the teeth have completely erupted. This is a most potent argument against their removal at these periods, when the hypertrophy is evidently a response to some physiological stimulus.

Crowe, Watkins and Rothholz[19] believe that partial occlusion of the crypts from partial tonsillectomy renders the patient more liable to secondary cardiac, joint and renal lesions. They have observed 8 cases with frequent attacks of tonsillitis for many years preceding, but never with anything but local symptoms. With the idea of stopping these attacks each of these patients had had a partial tonsillectomy performed with the guillotine or with the electric cautery under local anesthesia in each case. All went well

[18] A Functional Relation of the Tonsil to the Teeth, Boston Med. and Surg. Jour., 1909, clx, 635.

[19] Relation of Tonsillar and Nasopharyngeal Infections to General Systemic Disorders, Bull. Johns Hopkins Hosp., 1917, xxviii, 1.

until the next coryza, when joint symptoms appeared for the first time. Portions of the tonsils showed the crypts obscured by scar tissue. After their removal the joint symptoms gradually disappeared and the temperature returned to normal. The partial tonsillectomy, by narrowing the orifices of the crypts of the remaining portion of the tonsil, favored the retention of bacteria and pathological detritus and made the conditions more favorable for a general infection.

The end-results of 1000 tonsillectomies performed during the past five years at the Johns Hopkins Hospital have been carefully studied. These operations were performed under the rigorous routine of a surgical ward, with experienced anesthetists and assistants, and were regarded as major surgical operations. The cases were followed up in order to learn the subsequent history of disorders supposed to be secondary to a chronic focus of infection in the upper air passages.

In the "arthritis group" four classes of cases are recognized: (1) infectious arthritis; (2) myalgia; (3) rheumatoid arthritis; (4) acute rheumatic fever.

1. *Infectious Arthritis.* Tonsils and adenoids were removed in 91 cases. The ultimate result was noted in 31. In 24 the joints are normal; 4 are improved although the joints have never entirely cleared up; 2 are not improved; 1 is worse than at the time of operation.

2. *Myalgia.* Four cases were followed up after tonsillectomy. All are well.

3. *Rheumatoid Arthritis.* Nine cases were followed up. Only 2 are improved; 2 are not improved, but no new joints are involved; 5 cases are much worse.

The conclusion drawn from this group of cases is that only in very exceptional circumstances should one subject a patient with rheumatoid arthritis to an operation for the removal of tonsils. These patients are for the most part middle-aged people. Their disease is well advanced when they seek medical advice. There is often marked anemia and a distinct lessening of their ability to withstand pain. After such a trying operation as tonsillectomy it often requires many weeks or months before the patient regains the physical condition present at the time the tonsillectomy was performed.

4. *Acute Rheumatic Fever.* Twenty-five cases were followed up; 4 of these cases had a recurrence, 1 of which had been perfectly well after the removal of his tonsils.

It is quite evident that the tonsils are not the only portal of entry for the organisms that cause rheumatic fever.

Opinions of Orthopedic Surgeons. With a view to ascertaining the opinion of medical men who have an exceptional opportunity of studying cases of arthritis a series of questions was submitted to 177 orthopedic surgeons throughout the country.

The questions called for answers with definite figures and not for opinions or beliefs.

The replies show the trend of present medical thought. They also show that a large percentage of orthopedic surgeons replying to the questionnaire believe that the removal of so-called foci of infections in teeth and tonsils have produced improvement and cure in many cases of acute and chronic arthritis. The beneficial results are more evident in acute than in chronic arthritis. If removal of foci in the teeth and tonsils does not bring about improvement the majority of these surgeons depend upon general hygienic or stimulative treatment. A small percentage continue the search for other foci, with special reference to the gastro-intestinal tract. It is interesting to note that opinion as to the accuracy of the statement that most foci of infection are to be found in the head is equally divided.

STATISTICS OF THE WRITER'S CASES. For several years the writer has conducted an investigation of the relation of diseased conditions of the teeth and tonsils to arthritis. The study was made in collaboration with dentists and ear, nose and throat surgeons, and included both hospital and private patients.

It was determined at the outset to leave the diagnosis and treatment of dental and tonsillar conditions entirely to the judgment of these specialists and to abide by their decision in each case. The results were determined by the patients' statements and by examination as to general health and condition of the joints. It was attempted to ascertain if operations on the teeth and tonsils had produced in the joints:

1. Cure.
2. Relief of symptoms.
3. No improvement.
4. Aggravation of symptoms.

Whenever possible the patients were referred back to the special surgeon for reëxamination and after treatment following any operative procedure.

It is often impossible to determine what element in the treatment is responsible for the improvement or cure. Appropriate treatment for arthritis was instituted at the time the mouth and throat condition was being investigated and treated. When improvement is no more rapid than has been noticed for years under approved treatment for arthritis it is natural to attribute the progress to the true and tried methods.

Total number of cases, 40.

1. Diseased conditions of the teeth and tonsils, 29 cases: Of these (*a*) 12 were of the teeth alone; (*b*) 11 were of the tonsils alone; (*c*) 6 were of both teeth and tonsils.

2. Negative dental and nose and throat conditions, 8 cases: Of these 3 improved under treatment for arthritis; 2 were unimproved under treatment for arthritis; 3 could not be traced.

3. Dental and nose and throat examinations were not made in 3 cases: Of these 1 improved under treatment for arthritis; 2 could not be traced.

1 (*a*) Diseased conditions of the teeth alone, 12 cases: Of these 3 showed some improvement in the arthritis; 1 showed striking and immediate improvement; 3 improved after an interval of time had elapsed (1 of these last after several doses of autogenous vaccine); 2 were unimproved, all after the extraction of teeth; 1 was unimproved after a pyorrhea had been treated; 1 improved without operation; 1 could not be traced.

1 (*b*) Diseased conditions of the tonsils alone, 11 cases: Of these 2 were improved after tonsillectomy (1 of these was cured); 1 was unimproved after tonsillectomy; 1 was unimproved without tonsillectomy; 1 began to improve before tonsillectomy was performed; 1 was worse after tonsillectomy; 1 had a relapse after a tonsillectomy performed one year before; 1 refused operation.

1 (*c*) Diseased conditions of both teeth and tonsils, 6 cases: Of these 1 improved after extraction of teeth but relapsed later; 1 improved without operation; 1 was unimproved after extraction of teeth; 1 was unimproved after extraction of teeth and tonsillectomy; 1 was unimproved where operations were not performed; 1 refused operation.

In analyzing the above cases it will be seen that there was but one case which showed immediate improvement, which could be classed as a cure, following extraction of teeth, and but one such result following tonsillectomy.

Many of these cases which are classed as improved showed the improvement in their general health rather than in a changed appearance of the joints. It has seemed fair to consider them as better even if the improvement were slight.

In these few cases the improvement following proper treatment of dental disease was more noticeable than the improvement following operations on diseased tonsils.

In speaking of the above cases as improved or unimproved, either with or without operations on the teeth or tonsils, it is not implied that the operation, or the lack of operation, is responsible for the present condition of the patient. Many factors influence the result, and it is intended merely to state the condition of the patient when last seen.

As has been noted by others, diseased conditions of the teeth have been found more often in adults and diseased conditions of the tonsils more often in childhood.

SUMMARY. The relation of the teeth and tonsils to arthritis is at present a moot question. Billings and his followers point to the careful work of Rosenöw and others on the bacteriology of arthritis and to the numerous cases of improvement and cure of arthritis following removal of diseased teeth and tonsils. They believe that

this proves the accuracy of their contention that a focus of infection exists in the head in many of these cases. On the other hand, many trained pathologists and reputable clinicians have been unable to reproduce either the laboratory findings or the clinical results of the Chicago workers. Consequently they either reject the theory as a whole or accept it in a greatly modified form. It is probable that the pendulum has swung too far in the direction of the wholesale removal of teeth and tonsils. The truth will probably be found in a middle ground somewhere between these divergent theories.

There is undoubted improvement in numerous cases of arthritis following the removal of an abscessed tooth or a diseased tonsil or when a case of active pyorrhea has received proper treatment. On the contrary, many such cases are given similar careful treatment without affecting the progress of the joint condition in the slightest degree.

One reason for the failure to obtain successful results in arthritis by treatment of dental and tonsillar disease is that the cases have been selected without knowledge of the exact pathological condition present in the organ in question. Many apical abscesses in which nature had effected a cure by walling off the disease have been treated by extraction of teeth. This has resulted not only in the loss of valuable teeth, but has at times been the cause of a dissemination of the infection to other parts of the body, with dire results.

In the same way the crypts in certain areas of a tonsil may overcome an existing infection. These crypts are perfectly harmless. A tonsil in which the crypts are seared over by scar tissue, perhaps as the result of an incomplete tonsillectomy, may be a source of potent danger if the crypts contain an active focus of infection.

Success in treatment of these foci lies with the men who can distinguish the apical abscess and the diseased tonsil which are overcoming their infection by nature's methods. They must know by careful and special training when a tooth or a tonsil are active agents of infection. Such knowledge must be supplemented by accurate interpretation of dental roentgenograms and skilful laboratory work. Trite as the saying is, coöperation in such endeavor is the keynote of success.

Another reason for failure to alleviate arthritic cases is due to the fact that the focus of infection lies in some other part of the body. It may be discovered by further careful search in the lungs, heart, kidneys, genito-urinary or gastro-intestinal tracts, ductless glands, the nervous system and elsewhere. A certain number of cases are due to syphilis and to tuberculosis. Unfortunately in many cases it is never brought to light.

Many cases of arthritis are believed by thoughtful physicians to be due not to a localized collection of microörganisms but to an entirely different etiology. This class of cases is supposed to result from some disturbance of the metabolism, probably chemical in nature, which produces joint changes not always to be distinguished

from those caused by bacterial agency. They compose a fairly large share of the cases of chronic progressive arthritis seen in the daily routine of practice. A general flaccidity of tissues and relaxation of important organs accompanied by ptosis of the abdominal viscera often characterize these cases.

In acute arthritis the probability of producing a cure or improvement by the removal of a supposed focus in the teeth or tonsils is greater than in cases in the chronic stage. It is unreasonable to suppose that a restoration of function can be brought about in joints where extensive pathological changes have taken place.

One very suggestive fact brought out in this investigation has been the marked improvement in the general health of the patients when diseased conditions of the teeth and tonsils have been properly treated. It oftentimes seems as if a millstone had been removed from their necks. This is noted very commonly even when no change was apparent in the joint condition.

EXPERIMENTAL LESIONS IN THE CERVICAL SYMPATHETIC GANGLIA IN RELATION TO EXOPHTHALMIC GOITER.[1]

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That exophthalmic goiter, the clinical manifestations of which are due essentially to a greatly increased protein metabolism, is the joint result of disturbance in the several glands concerned with metabolism there can be little doubt. The fact that the thyroid shows a pronounced and constant series of functional changes parallel with the course of the disease and the further fact that removal of the gland arrests the symptoms is convincing though not absolute proof that the thyroid is the secretory gland the hyperfunction of which initiates the metabolic disturbance.

But is the primary hyperfunction of the thyroid the result of primary pathological change within the gland itself or of direct stimulation from its nerve supply? Cannon's[2] experimental production in cats of some of the symptoms of exophthalmic goiter by continuous stimulation of the thyroid through the sympathetic system suggests the latter. Durante and I[3] have shown that in all

[1] Presented before the Association of American Physicians, Atlantic City, N. J., May 3, 1917.

[2] Cannon, W. B., Binger, C. A. L., and Fitz, R.: Experimental Hyperthyroidism, Am. Jour. Physiol., 1914–15, xxxvi, 363–364.

[3] Wilson, L. B., and Durante, L.: Changes in the Superior Cervical Sympathetic Ganglia Removed for the Relief of Exophthalmos, Jour. Med. Research, 1916, N. S., xxxiv, 273–296. Wilson, L. B.: The Pathological Changes in the Sympathetic System in Goiter, Am. Jour. Med. Sc., 1916, cliii, 799–812. Wilson, L. B.: Further Study of the Histopathology of the Autonomic Nervous System in Goiter, Jour. Lab. and Clin. Med., 1917, ii, 295–307.